



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Fisheries Science Center
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March 30, 2004

MEMORANDUM FOR: D. Robert Lohn
NW Regional Administrator
[Signature]
FROM: Usha Varanasi
Science and Research Director
NW Fisheries Science Center
SUBJECT: Review of "Petition to list the Cherry Point population of Pacific herring, *Clupeapallasi*, as "threatened" or "endangered" under the Endangered Species Act, 16 U.S.C. § 1531 *et seq.* (1973 as amended)"

This memorandum is in response to the Region's request of March 12, 2004 for the Northwest Fisheries Science Center (NWFSC) to provide a scientific review of a new petition to list the Cherry Point Pacific herring stock as a distinct population segment (DPS) under the Endangered Species Act (ESA).

Background

On February 8, 1999, NOAA Fisheries received an ESA petition from Sam Wright of Olympia, Washington to list Pacific herring (along with 17 other species) in Puget Sound, Washington. On June 21, 1999, NOAA Fisheries accepted the petition for seven species, including Pacific herring. Subsequently a Pacific Herring Biological Review Team (BRT) was formed, consisting of scientists from the NWFSC, Alaska Fisheries Science Center, National Ocean Service, and the U.S. Fish and Wildlife Service. This BRT concluded that spawning populations of Pacific herring from Puget Sound (including the Cherry Point population) and the Strait of Georgia constitute a Georgia Basin Pacific Herring Distinct Population Segment. The DPS's range includes the marine waters of Puget Sound, the Strait of Georgia, and eastern Juan de Fuca Strait in both the US and Canada. The BRT concluded that this Pacific Herring DPS, containing the petitioned Puget Sound populations, was neither in danger of extinction nor likely to become so in the foreseeable future (see Stout et al. 2001).

New information presented in the petition

On January 22, 2004, NOAA Fisheries received a petition from the Center for Biological Diversity and co-petitioners to designate Cherry Point Pacific herring as a DPS and list it as a threatened or endangered species under the ESA. The Center's review of the petition indicates that the majority of the physical, physiological, ecological and behavioral



evidence for separation of Cherry Point herring from other populations, as cited in the current petition, was considered by the BRT at the time of the status review of Puget Sound Pacific herring (Stout et al. 2001). This includes the data regarding spawn timing and location, habitat, and growth and age distribution of the Cherry Point Pacific herring stock. Data in the new petition not available at the time of the original BRT's decision include the genetic information cited as Beacham et al. (2001), the otolith stable isotope data (Gao et al. 2001), spawner biomass estimates for Cherry Point herring from 2001-2003, and citation of various oral presentations that occurred at the 2002 Herring Summit and Pacific Coast Herring Workshop..

Questions related to Substantial information

In the March 12, 2004 memo the Region requested that the Center review whether the petition presents substantial information (*especially information that the BRT did not previously consider*) that the petitioned action may be warranted and specifically to answer the following five questions:

- 1) Does the petition present substantial information regarding the discreteness of the Cherry Point Pacific herring stock?
- 2) Does the petition present substantial information regarding the significance of the Cherry Point Pacific herring stock?
- 3) If the answers to questions (1) and (2) are "yes" (i.e., the petition presents Substantial information indicating that the Cherry Point herring stock may qualify as a DPS), then does the petition present Substantial information indicating that a putative Cherry Point DPS may be threatened or endangered throughout all or a significant portion of its range?
- 4) If the answers to questions (1) or (2) or both is "no" (i.e., the petition does not present Substantial information indicating that the Cherry Point herring stock may qualify as a DPS), then does the petition present Substantial information indicating that the Cherry Point herring stock may represent a significant portion of the range of the presently identified Georgia Basin Pacific herring DPS?
- 5) If the answer to question (4) is "yes", then does the petition present substantial information indicating that the Cherry Point herring stock may be in danger of extirpation?

The following narrative addresses each question in turn.

(1) Does the petition present substantial information regarding the discreteness of the Cherry Point Pacific herring stock?

The petition cites recent microsatellite DNA studies of Pacific herring by Beacham et al. (2001) and Beacham (2002; abstract of oral presentation) that appear to indicate that the Cherry Point population is somewhat genetically distinct from other Pacific herring in British Columbia. The manner in which this study is cited in the petition gives the incorrect impression that there have been two independent studies, when in fact Beacham et al. (2001) and Beacham (2002) refer to a single study. The study detailed in Beacham

et al. (2001) focused primarily on British Columbia Pacific herring populations, and included only one Washington sample (Cherry Point) from a single year. The most notable result from the Beacham et al. (2001) study was the nearly complete lack of genetic differentiation among Pacific herring at all spatial scales within British Columbia. Beacham et al. (2001) stated that “Annual variation in allele frequencies within the five stocks of herring in British Columbia defined for assessment and management was larger than any differences among stocks, and thus, on average, there is no genetic differentiation among the five defined stocks [Strait of Georgia, West Coast Vancouver Island, Central Coast, North Coast, and Queen Charlotte Islands].” However, they did find a couple of samples, including the sample from Cherry Point and two other locations within the Georgia Basin Pacific Herring DPS (Secret Cove and Portage Inlet = Esquimalt/Victoria Inner Harbor), with allele frequencies that were statistically different from other samples. This result does not necessarily provide substantial information regarding the discreteness of the Cherry Point population, for the following reasons:

- Other than the un-scaled figure referenced in the petition (Figure 7 in the petition; Figure 1 from Beacham et al. 2001), Beacham et al. (2001) provide no specific information on the level of genetic differentiation of the Cherry Point population. Merely rejecting the null hypothesis of completely random mating between putative groups [the test performed by Beacham et al. (2001) and presented in their Table 4] does not indicate that two populations are necessarily “markedly” separated from each other [see Waples et al. (1998) for a discussion of this issue].
- The Beacham et al. (2001) study included only one population from Washington State; therefore the discussion in the petition regarding the distinctiveness of the Cherry Point population from other Washington populations is not supported by the results of the Beacham et al. study.
- The Cherry Point population was only sampled in a single year (2000), so there is no information regarding the temporal stability of the observed differences (the petition incorrectly claims that Beacham et al. (2001) showed that allele frequencies observed at Cherry Point were temporally stable).

The petition cited Gao et al. (2001) as evidence “...that Cherry Point herring inhabit unique environments that isolate them from other Puget Sound herring populations.” Gao et al. (2001) analyzed oxygen and carbon isotope ratios in otoliths (ear bones) from spawning Pacific herring collected at Cherry Point in north Puget Sound and at Port Orchard and Squaxin Pass in south Puget Sound. Isotope ratios from nuclei of otoliths from the two southern Puget Sound samples were not significantly different from one another; however, Cherry Point otoliths were significantly different from the two southern Puget Sound samples. The Cherry Point isotope ratios suggested that herring from this location experience lower salinities as larvae and juveniles than herring from southern Puget Sound. However, Gao et al. (2001) noted that “...there are some crossing samples in the database.” Their figure 3 shows that isotope ratios from 3 of the 32 Cherry Point fish fell well within the range of values shown for the other two sites. This overlap may indicate some degree of mixing of herring between the two areas or that

water conditions characteristic of south Puget Sound may also occur in the areas frequented by Cherry Point herring during early life stages. Gao et al. (2001) also studied isotope ratios of second summer (1999) otolith rings in these three herring stocks. The results indicated that most south Puget Sound herring were rearing in high salinity conditions and were therefore “moving to the ocean” (migratory stock) and that most Cherry Point herring with otolith isotope ratios indicative of lower salinities “might still remain in the spawning ground” (non-migratory stock). This result is surprising since previous studies (based on limited tagging data and the relatively high growth rate of Cherry Point herring) had speculated that Cherry Point herring migrate to feed in offshore waters, whereas other Puget Sound herring (with slower growth rates and a smaller size-at-age) were likely non-migratory. Gao et al. (2001) did not consider the possibility that “migratory” fish may have been merely feeding deeper in the water column where salinity is higher than “non-migratory” fish. Although the otolith isotope approach may provide useful insights and supplementary information, the results of Gao et al. (2001) do not present substantial information regarding the discreteness question for Cherry Point Pacific herring.

Center scientists reviewed additional information related to the discreteness question that was readily available (i.e., currently within agency files) and that has been released or published since the 2001 Status Review (Stout et al. 2001), but that was not included in the petition. Several relevant publications have appeared including two peer-reviewed papers summarizing results of Pacific herring tagging operations in British Columbia (Hay et al. 2001, Hay and McKinnell 2002) and two non peer-reviewed reports (Ware and Schweigert 2001, Beacham et al. 2002), one summarizing metapopulation structure of British Columbia herring (Ware and Schweigert 2001) and the other consisting of an updated version of Beacham’s microsatellite DNA study of population structure of British Columbia herring (Beacham et al. 2002). Hay et al. (2001), Hay and McKinnell (2002), and Ware and Schweigert (2001) are all based on the extensive Pacific herring tagging data base that was reviewed extensively in the previous Status Review (Stout et al. 2001) and do not directly relate to Cherry Point.

In a continuation of their earlier study, Beacham et al. (2002) analyzed microsatellite DNA variation in Pacific herring from additional sampling sites including two in California (Tomales and Sausalito bays), measured variation at 13 rather than 15 loci, and added temporal samples at several locations. However, as in Beacham et al (2001), only a single Cherry Point sample collected in the year 2000 is included in the analysis (Beacham et al. 2002). Beacham et al. (2002) found virtually no structuring of Pacific herring populations within the five managed herring stocks in British Columbia. In addition, Beacham et al. (2002) found “...little evidence for genetically discrete populations of herring spawning in different bays or even inlets within local stocks or management groupings.”

Beacham et al. (2002) provide an updated figure (based on 78 sample locations) similar to the one reproduced as Figure 7 in the petition (based on 65 sample locations); however, as before the figure is un-scaled and provides no specific information on the level of genetic differentiation of the Cherry Point population. In this figure (Beacham et

al. 2002; their figure 7) Cherry Point clusters with Portage Inlet, Sausalito Bay, Tomales Bay, Skidegate Inlet, and Secret Cove samples.

However, without samples collected in multiple years it is impossible to analyze the temporal stability of allele frequency differences found between Cherry Point and sample locations in British Columbia. This requirement for temporal samples is illustrated by the microsatellite DNA study of O'Connell et al. (1998), whose finding of population structure in Pacific herring from Alaska was negated by "subsequent sampling ... that indicated that temporal or annual variation was as large or larger than any differentiation between putative local populations..." (Beacham et al. 2002, p. 11).

In conclusion, the genetic studies of (Beacham et al. 2001, 2002) do not provide substantial information that the Cherry Point stock is discrete, as defined by the DPS policy. It is possible that additional data (i.e., an upcoming Washington Department of Fish and Wildlife study) coupled with further analysis of the Beacham et al. datasets could be used to make the case that the population meets the discreteness criteria.

(2) Does the petition present substantial information regarding the significance of the Cherry Point Pacific herring stock?

The Pacific Herring BRT reviewed and discussed the significance of the Cherry Point Pacific herring stock with respect to the taxon to which it belongs (i.e., the whole species) and reported its findings in the original status review (Stout et al. 2001). The only data presented in the petition that appear relevant to this question and that were not available to the BRT are the Beacham et al. (2001) genetic data. As discussed above, results of the Beacham genetic study cited in the petition as Beacham et al. (2001) and the updated document of this genetic study (Beacham et al. 2002) do not indicate that the Cherry Point population differs "markedly" from other populations within the Georgia Basin Pacific Herring DPS. As with the discreteness question, it is possible that additional data or further analysis might be used to make the case that the population meets the significance criteria, but based on the results presented in Beacham et al. (2001, 2002), this seems unlikely due to the extremely low levels of genetic differentiation observed.

In reference to the "significance" question, the petition makes several statements on page 33 under "Marked Difference in Genetic Characteristics," which do not accurately characterize the results of the Beacham et al. (2001) study and require clarification.

- The petition states: "Recent studies on Pacific herring microsatellite [sic] DNA found Cherry Point herring to be the most genetically divergent population in Washington." However, the Cherry Point herring population was the only Washington State herring population analyzed by Beacham et al. (2001).
- The petition states: "There was a significant difference detected between Cherry Point herring and other Pacific herring at all 12 loci that were screened (Beacham et al. 2001)." However, Beacham et al. (2001) analyzed allele variation at 15, not 12, microsatellite loci.

- The petition states: “Canadian studies determined that the Cherry Point population was genetically distinct from other Puget Sound, Strait of Georgia and Canadian herring populations with the degree of genetic separation from the other Georgia Strait and Puget Sound stocks comparable to that found between ESUs of coho salmon (*Oncorhynchus kisutch*) (Beacham 2002).” This statement does not appear to be supported by the cited abstract - (Beacham 2002). At another point in the petition (p. 29) it is stated that Beacham (2002) indicated that Cherry Point herring were stated to be genetically separated from the other Georgia Strait and Puget Sound stocks at a level comparable to that found between stocks of coho salmon. Thus the above reference to ESUs may be a typographical error. In addition, Cherry Point was the only Puget Sound herring stock reported upon by Beacham (2002) or Beacham et al. (2001); genetic relationships with the other 17 Puget Sound herring stocks were not part of these analyses.

In conclusion the genetic studies of (Beacham et al. 2001,2002) do not provide substantial information that the Cherry Point stock is significant, as defined by the DPS policy. It is possible that additional data (i.e., an upcoming Washington Department of Fish and Wildlife study) coupled with further analysis of the Beacham et al. datasets could be used to make the case that the population is markedly separated in its genetic characteristics and thus meets the significance criteria, but this appears unlikely based on the data and analyses currently available.

(3) If the answers to questions (1) and (2) are “yes” (i.e., the petition presents substantial information indicating that the Cherry Point herring stock may qualify as a DPS), then does the petition present substantial information indicating that a putative Cherry Point DPS may be threatened or endangered throughout all or a significant portion of its range?

The answers to questions (1) and (2) are both “no.”

(4) If the answers to questions (1) or (2) or both is “no” (i.e., the petition does not present substantial information indicating that the Cherry Point herring stock may qualify as a DPS), then does the petition present substantial information indicating that the Cherry Point herring stock may represent a significant portion of the range of the presently identified Georgia Basin Pacific herring DPS?

Since the current petition states that the Cherry Point herring stock is a DPS, in and of itself, there is little information in the petition regarding whether or not the Cherry Point herring stock may represent a significant portion of the range of the presently defined Georgia Basin Pacific Herring DPS, as defined in NMFS (2001). However, this issue was previously discussed at length by the Pacific Herring BRT. The Pacific herring Status Review (Stout et al. 2001, p.145), stated that

...some stocks within the Georgia Basin, such as Cherry Point and Discovery Bay, have declined to such an extent that they may meet the IUCN criteria to be considered “vulnerable”. Although the BRT

recognized that herring populations in north Puget Sound and Puget Sound proper may be vulnerable to extinction, these populations [i.e., Cherry Point] represent a relatively small portion of the overall DPS of herring in the Georgia Basin.”

This question was examined from several different perspectives, including number of overall stocks in the DPS, percentage of spawner biomass in the DPS, percentage of total population size within the DPS, and percentage of spawning habitat. Although the BRT recognized that Cherry Point is an important component of the diversity within the Georgia Basin DPS, the consensus opinion of the 2001 BRT was that from every perspective, the Cherry Point stock did not represent a significant portion of the range of the overall Georgia Basin Pacific Herring DPS.

(5) If the answer to question (4) is “yes”, then does the petition present substantial information indicating that the Cherry Point herring stock may be in danger of extirpation?

The answer to question (4) is “no.”

New abundance data and conclusions

The petition presents three years of population abundance data (2001-2003) for Cherry Point herring that has appeared since the status review. The population has shown an increasing trend over these three years with the 2003 spawner biomass estimate of 1,611 short tons reaching its highest level since 1996. Other readily available data that has appeared since the Pacific herring status review for other portions of the Georgia Basin DPS were presented in reports by Jagielo (2002) and Wallace and Glavin (2003). Spawner biomass estimates presented in Jagielo (2003) indicate that the overall Puget Sound Pacific herring biomass was at a ten year high of over 17,000 short tons in 2001. Biomass estimates for 2002 and 2003 for the 18 non-Cherry Point stocks in Puget Sound were not readily available. In 2003, the estimated Pacific herring spawner biomass in the Canadian portion of the DPS (Strait of Georgia stock) was at an all time high of more than 143,000 short tons (Wallace and Glavin 2003). Since these data present an overall more positive outlook for the Georgia Basin DPS than existed at the time of the status review, it is unlikely that they would cause the Pacific Herring BRT to alter its assessment that “the Georgia Basin DPS of Pacific herring are neither at **risk** of extinction not likely to become so” in the foreseeable future (Stout et al. 2001). This does not mean that the concerns expressed by the petition regarding the status of the Cherry Point population are not valid. Indeed, the BRT also expressed concern regarding the state of the Puget Sound ecosystem, including the Cherry Point herring population (Stout et al. 2001).

In summary, the Center does not believe the petition presents substantial information indicating that the Cherry Point Pacific herring stock may qualify as a DPS, in regards to either the discreteness or significance criteria. The Center also does not believe that the petition presents substantial information indicating that the Cherry Point Pacific herring

stock represents a significant portion of the range of the Georgia Basin Pacific Herring DPS. In addition, the Center's analysis of abundance data for the Georgia Basin Pacific Herring DPS suggests that the petition does not present substantial information that the Georgia Basin DPS of Pacific herring is either at risk of extinction or likely to become so in the foreseeable future.

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